U.S. DEPARTMENT OF COMMERCE PATENT & TRADEMARK OFFICE

B/O Form PTO-1390	**Transmittal Letter to the United States Designated/Elected Office (DO/EO/US) Concerning a Filing Under 35 USC 371**	*Attorney's Docket Number* PATENT TRADEMARK OFFICE GERE3001/JEK
		U.S. Application Number if known 09/786366

International Application Number PCT/EP99/06555	*International Filing Date* 10 September 1999	*Priority Date Claimed* 15 September 1998

Title of Invention
METHOD AND APPARATUS FOR VIDEO SIGNAL PROCESSING

Applicant(s) for DO/EO/US
Peter GERETS

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items under *35 USC 371*:

1. ☒ This is a **FIRST** submission of items concerning a filing under *35 USC 371*.

2. ☐ This is a **SECOND** or SUBSEQUENT submission of items concerning a filing under *35 USC 371*.

3. ☒ This express request to begin national examination procedures *(35 USC 371(f))* at any time rather than delay examination until the expiration of the applicable time limit set in *35 USC 371(b)* and PCT Articles 22 and 39(1).

4. ☒ A proper **Demand** for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. ☒ A copy of the International Application as filed *35 USC 371(c)(2)*.
    a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
    b. ☒ has been transmitted by the International Bureau.
    c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).

6. ☐ A translation of the International Application into English *(35 USC 371(c)(2))*.

7. ☒ Amendments to the claims of the International Application under PCT Article 19 *(35 USC 371(c)(3))*
    a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
    b. ☐ have been transmitted by the International Bureau.
    c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
    d. ☒ have not been made and will not be made.

8. ☐ A translation of the amendments to the claims under PCT Article 19 *(35 USC 371(c)(3))*.

9. ☒ An oath or declaration of the inventor(s) *(35 USC 371(c)(4))*. (☒ Executed   ☐ Unexecuted)

10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 *(35 USC 371(c)(5))*.

Items 11 to 16 below concern other document(s) or information included:

11. ☐ An Information Disclosure Statement under *37 CFR 1.97* and *1.98*.

12. ☒ An assignment document for recording. A separate cover sheet in compliance with *37 CFR 3.28* and *3.31* is included.

13. ☐ A **FIRST** preliminary amendment.
     ☐ A **SECOND** or SUBSEQUENT preliminary amendment.

14. ☐ A substitute specification.

15. ☐ A change of power of attorney and/or address letter.

16. ☒ Other items or information: 3 sheets formal drawings

Application Number (if Known)	International Application Number	Attorney's Docket Number	
09/786366	PCT/EP99/06555	GERE3001/JEK	
		Calculations	PTO USE ONLY

17. The following fees are submitted:

Basic National Fee (37 CFR 1.492(a)(1)-(5)):
- ☒ Search report has been prepared by the EPO or JPO $860.00
- ☐ International Preliminary Examination Fee paid to USTPO (37 CFR 1.482) $690.00
- ☐ No International Preliminary Examination Fee paid to USTPO (37 CFR 1.482)
  but International Search Fee paid to USTPO (37 CFR 1.445(a)(2)) $710.00
- ☐ Neither International Preliminary Examination Fee (37 CFR 1.482) nor
  International Search Fee (37 CFR 1.445(a)(2)) paid to USTPO $1000.00
- ☐ International Preliminary Examination Fee paid to USTPO (37 CFR 1.482)
  and all claims satisfied provisions of PCT Article 33(1)-(4) $100.00

ENTER APPROPRIATE BASIC FEE AMOUNT		$ 860.00	

Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).

CLAIMS	NUMBER FILED		NUMBER EXTRA	RATE		
Total Claims	21	-20 =	1	× $18.00	$ 18.00	
Independent Claims	2	-3 =		× $80.00		
Multiple Dependent Claims (if applicable)				+ $270.00	$	

TOTAL OF ABOVE CALCULATIONS		$ 878.00	

Reduction by ½ for filing by small entity, if applicable. Small Entity Status is asserted pursuant to 37 CFR 1.27 for this application.

SUBTOTAL		$ 878.00	

Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)).

TOTAL NATIONAL FEE		$ 878.00	

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property.

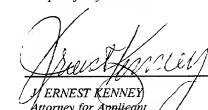|			
		$ 40.00	
TOTAL FEES ENCLOSED		$ 918.00	
	Amount to be:	Refunded:	
		Charged:	

a. ☒ A check in the amount of ___$918.00___ to cover the fees is enclosed.

b. ☐ Please charge my **Deposit Account Number 02-0200** in the amount of _$_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to **Deposit Account Number 02-0200.** A duplicate copy of this sheet is enclosed.

Note: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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DATE: 15 March 2001

Respectfully submitted,

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09/786366

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JC08 Rec'd PCT/PTO

PATENT
1 5 MAR 2001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

International Patent Application
No. PCT/EP99/06555

PCT/DO/EO/US

International Filing Date: 10 September 1999

Applicant: Peter GERETS

For: METHOD AND APPARATUS FOR VIDEO SIGNAL PROCESSING

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

This paper accompanies documents submitted to establish the U.S. national stage of the above-identified international patent application.

The claims were not amended during the international phase. Before calculation of the filing fee and before examination, please amend the application as follows:
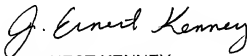
IN THE CLAIMS:

Please amend the original as-filed claims as shown on the appended APPENDIX OF CLAIMS. Also appended hereto is an APPENDIX OF MARKED-UP CLAIMS showing the amendments.

International Application No. PCT/EP99/06555

REMARKS

All rights are reserved to the original claimed subject matter. The claims have been amended to reduce the filing fees and to better conform to U.S. claim format. Examination of the application as amended is respectfully requested.

Respectfully submitted,
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Date: March 15, 2001

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APPENDIX OF CLAIMS

1.   Method for video processing, wherein possible movement between successive fields of the images split into even and odd is detected and the mode, i.e. video mode or film mode is determined, characterized in that the sequence of movement or standstill between successive fields is detected and this sequence over a number of fields is stored in a memory, followed by said sequence being compared with patterns inherent to the mode and, if ordinary video mode is detected, median filtering is carried out whereas, if film mode (2:2 pull-down of 3:2 pull-down) is detected, the median filtering is switched off and, in synchronization with the film phase, the even and odd fields which match and are derived from one and the same film image are merged again until the original film image is obtained and said image is repeated until again a following original film image can be constructed by means of the abovementioned merging.

2.   Method according to Claim 1, characterized in that if a film mode is detected, the length of the movement sequence which is stored in the memory is shortened.

3(Amended). Method according to claim 1, characterized in that the movement detection, i.e. the detection of the abovementioned sequence of movement and standstill, can be performed a three-point median operation, after which the result of said median filtering operation and the incoming information of a following field is filtered by two low-pass filters, the absolute difference of the result of these two low-pass filter is calculated and the differences are summed, the sum, possibly divided by a number, being compared with a threshold value, the result of said comparison forming the abovementioned sequence stored in a memory, of the movement and standstill between successive fields.

4. Method according to Claim 3, characterized in that, depending on whether

the abovementioned sum is larger or smaller than the threshold value, a different binary number is stored in a memory, the sequence of binary numbers in said memory forming the abovementioned sequence of movement and standstill between successive fields.

5(Amended). Method according to Claim 3, characterized in that the threshold value is calculated taking into account the luminance value of the current processed image.

6. Method according to Claim 5, characterized in that the total luminance sum is calculated and the nominal threshold value chosen is a specific fraction of said luminance sum, said nominal value optionally being adjusted, in particular being doubled or halved, in order to take account of the processing mode and, if edge boosting is being carried out, to take account of the status of said edge boosting.

7(Amended). Method according to claim 1, characterized in that, if film mode is detected, the processing of the data is synchronized with the film phase by using oscillating shift to continuously transmit a sequence corresponding to the 2:2 pull-down mode and/or a sequence corresponding to the 3:2 pull-down mode and, if one of the corresponding mode is detected, to synchronize with a synchronization pulse transmitted by the detection of the sequences of movement and standstill between the successive fields.

8. Method according to Claim 7, characterized in that in the event of non-synchronization or detection of an error in the film phase, a changeover to film the synchronization mode is carried out, the sensitivity of the detection of movement again being set to a high level and the processing temporarily again being carried out by median filtering until the film phase is observed again.

9(Amended). Method according to claim 5, characterized in that in the event

of film mode being detected and of synchronization the threshold value is increased so that the sensitivity of the detection of movement or standstill decreases.

10(Amended). Method according to claim 1, characterized in that the incoming signals are subjected to edge boost by said signals being filtered by means of two phase-linear filters having a coefficient sum of 0, namely a band-pass filter preferably having the coefficients -1 0 2 -1 and a high-pass filter having, for example, the coefficients -1 2 -1, after which the result of these filtering operations is merged and scaled.

11(Amended). Method according to claim 1, characterized in that the video signals to be processed are subjected to doubling or quadrupling and/or field rate doubling.

12. Method according to Claim 11, characterized in that the interlaced video signals to be processed are converted into non- interlaced video signals by means of a 3-point median filtering operation whose result is stored in a memory bank, and a field rate upconversion is performed by said memory bank constantly being read out at a higher rate than normal, preferably double the rate, for example at a frequency of 100 or 120 Hz instead of 50 or 60 Hz.

13. Method according to Claim 11, characterized in that the interlaced video signals to be processed are converted into non- interlaced video signals by means of a 3-point median filtering operation whose result is stored in a first memory bank and these video signals are simultaneously subjected to an interpolation whose result is stored in a second memory bank, after which successively a line from the one and a line from the other memory bank is read, and a field rate upconversion is performed by the contents of successively the first and the second memory bank constantly being read out at a higher rate than normal, preferably double the rate, for example at a frequency of 100 or 120 Hz instead of 50 or 60 Hz and, for correct interlacing, the

outgoing frame pulse being shifted, every other frame, by half a line.

14(Amended). Apparatus for employing the method according to claim 1, characterized in that it includes a movement detector (11), a film mode/video mode detector connected thereto, a synchronizer (21) to synchronize processing with the film phase, and a film processor proper.

15. Apparatus according to Claim 14, characterized in that the movement detector (11) is connected to a median filter (1) having as inputs the current field and the next field of the video images and includes two low-pass filters (13 and 14), one of which connects to the output of the median filter (1) and the other has as an input (12) the information of the next incoming field, a differentiator (15) which connects to the two low-pass filters (13 and 14) to calculate the between the outputs of these, a summator (16) connected to said differentiator (15), a counter (17) connected to said summator (16) and a comparator (18) connected thereto for comparing the output of the counter (17) with a threshold value.

16. Apparatus according to Claim 15, characterized in that the film mode/video mode detector includes a shift register (19) in which the result of the comparator (18) over a number of fields is stored, so that a comparison is possible with a pattern inherent to a specific mode.

17(Amended). Apparatus according to claim 14, characterized in that the synchronizer (21) includes at least one oscillating shift register or socalled "syncer" (22 or 23) which continuously transmits the sequence corresponding to the sequence of movement and standstill between successive fields for 2:2 pull-down or 3:2 pull-down, respectively, and preferably two shift registers or "syncers" (22 and 23), one for 2:2 pull-down and one for 3:2 pull-down.

18(Amended). Apparatus according to claim 14, characterized in that the film

processing proper includes means for merging matching fields of a film image and for repeating the merged images.

19. Apparatus for video processing, characterized in that they include means for employing doubling and/or means for performing quadrupling, and a field rate converter from, for example, 50 or 60 Hz to 100 or 120 Hz.

20(Amended). Apparatus according to claim 14, characterized in that as well as a movement detector (11), a film mode/video detector, a synchronizer (21) and a film processor it includes means for employing doubling and/or means for performing quadrupling, and a field rate converter.

21(Amended). Apparatus according to claim 15, characterized in that the means for performing doubling and/or the means for performing quadrupling include a median filter (1) which also forms part of the movement detector (11).

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APPENDIX OF MARKED-UP CLAIMS

3(Amended). Method according to [any one of the preceding claims] claim 1, characterized in that the movement detection, i.e. the detection of the abovementioned sequence of movement and standstill, can be performed a three-point median operation, after which the result of said median filtering operation and the incoming information of a following field is filtered by two low-pass filters, the absolute difference of the result of these two low-pass filter is calculated and the differences are summed, the sum, possibly divided by a number, being compared with a threshold value, the result of said comparison forming the abovementioned sequence stored in a memory, of the movement and standstill between successive fields.

5(Amended). Method according to Claim 3 [or 4], characterized in that the threshold value is calculated taking into account the luminance value of the current processed image.

7(Amended). Method according to [any one of the preceding claims] claim 1, characterized in that, if film mode is detected, the processing of the data is synchronized with the film phase by using oscillating shift to continuously transmit a sequence corresponding to the 2:2 pull-down mode and/or a sequence corresponding to the 3:2 pull-down mode and, if one of the corresponding mode is detected, to synchronize with a synchronization pulse transmitted by the detection of the sequences of movement and standstill between the successive fields.

9(Amended). Method according to [any one of claims 5 to 8] claim 5, characterized in that in the event of film mode being detected and of synchronization the threshold value is increased so that the sensitivity of the detection of movement or standstill decreases.

10(Amended). Method according to [any one of the preceding claims] claim 1, characterized in that the incoming signals are subjected to edge boost by said signals being filtered by means of two phase-linear filters having a coefficient sum of 0, namely a band-pass filter preferably having the coefficients -1 0 2 -1 and a high-pass filter having, for example, the coefficients -1 2 -1, after which the result of these filtering operations is merged and scaled.

11(Amended). Method according to [any one of the preceding claims] claim 1, characterized in that the video signals to be processed are subjected to doubling or quadrupling and/or field rate doubling.

14(Amended). Apparatus for employing the method according to [any one of the preceding claims] claim 1, characterized in that it includes a movement detector (11), a film mode/video mode detector connected thereto, a synchronizer (21) to synchronize processing with the film phase, and a film processor proper.

17(Amended). Apparatus according to [any one of Claims 14 to 16] claim 14, characterized in that the synchronizer (21) includes at least one oscillating shift register or socalled "syncer" (22 or 23) which continuously transmits the sequence corresponding to the sequence of movement and standstill between successive fields for 2:2 pull-down or 3:2 pull-down, respectively, and preferably two shift registers or "syncers" (22 and 23), one for 2:2 pull-down and one for 3:2 pull-down.

18(Amended). Apparatus according to [any one of Claims 14 to 17] claim 14, characterized in that the film processing proper includes means for merging matching fields of a film image and for repeating the merged images.

20(Amended). Apparatus according to [any one of Claims 14 to 18 and according to Claim 19] claim 14, characterized in that as well as a movement detector (11), a film mode/video detector, a synchronizer (21) and a film processor it includes

means for employing doubling and/or means for performing quadrupling, and a field rate converter.

21(Amended). Apparatus according to [Claims 15 and 20] <u>claim 15</u>, characterized in that the means for performing doubling and/or the means for performing quadrupling include a median filter (1) which also forms part of the movement detector (11).

METHOD AND APPARATUS FOR VIDEO SIGNAL PROCESSING

The present invention relates to a method for video
processing, wherein possible movement between
5   successive fields of the images split into even and odd
is detected and the mode, i.e. video mode or film mode
is determined.

More in particular, the invention relates to the
10   processing of video signals from a video tape, a DVD, a
laser disc, a tuner, etc. and therefore of standard
PAL, SECAM and NTSC video signals.

Given that, in particular in the case of film mode, be
15   it so-called "2:2 pull-down" or so-called "3:2 pull-
down", which involve the film images being split into
even and odd fields, the quality of the image on the
monitor can exhibit annoying effects if these signals
are processed in the classical manner, it is known to
20   determine, via movement detection, between successive
fields, according to what mode the current video signal
was converted in order then to carry out specific
further processing of the film mode signals.

25   With known methods, the movement detection is carried
out by detecting possible movement of the edges of the
fields, the result being that rapid intervention will
take place in the event of many details in a field.
This requires a large number of auxiliary devices such
30   as a battery of correlators.

Employing these known methods therefore requires a
relatively expensive and bulky apparatus.

35   It is an object of the invention to provide a method
for video processing which avoids these and other
drawbacks and which, even in the case of film mode, is
able to display a high-quality image on the monitor,

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while using a relatively inexpensive apparatus which
can be of compact design.

This object is achieved according to the invention by
5   the sequence of movement or standstill between
successive fields being detected and this sequence over
a number of fields being stored in a memory, followed
by said sequence being compared with patterns inherent
to the mode and, if ordinary video mode is detected,
10   median filtering is carried out whereas, if film mode
(2:2 pull-down or 3:2 pull-down) is detected, the
median filtering is switched off and, in
synchronization with the film phase, the even and odd
fields which match and are derived from one and the
15   same film image are merged again until the original
film image is obtained and said image is repeated until
again a following original film image can be
constructed by means of the abovementioned merging.

20   The movement detection, i.e. the detection of the
abovementioned sequence of movement and standstill, can
be performed by a three-point median filtering
operation, after which the result of said median
filtering operation and the incoming information of a
25   following field is filtered by two low-pass filters,
the absolute difference of the result of these two low-
pass filters is calculated and the differences are
summed, the sum, possibly divided by a number, being
compared with a threshold value, the result of said
30   comparison forming the abovementioned sequence, stored
in a memory, of the movement and standstill between
successive fields.

The video signals to be processed are preferably
35   subjected to doubling, and preferably also quadrupling
and preferably also field rate doubling.

The invention also relates to an apparatus which is particularly suitable for employing the method according to any one of the above embodiments.

5   The invention therefore relates to an apparatus which includes a movement detector, a film mode/video mode detector connected thereto, synchronization means to synchronize processing with the film phase, and a film processor proper.

10

Preferably, the movement detector is connected to a median filter having as inputs the current field and the next field of the video images, and includes two low-pass filters, one of which connects to the output

15 of the median filter and the other has as an input the information of the next incoming field, a differentiator which connects to the two low-pass filters to calculate the difference between the outputs of these, a summator connected to said differentiator,

20 a counter connected to said summator and a comparator connected thereto for comparing the output of the counter with a threshold value.

Preferably, the film mode/video mode detector includes

25 a shift register in which the result of the comparator over a number of fields is stored, so that a comparison is possible with a pattern inherent to a specific mode.

The apparatus may include means for employing doubling

30 and/or means for performing quadrupling, and a field rate converter from 50 or 60 Hz to 100 or 120 Hz.

With a view to providing a better demonstration of the characteristics of the invention, preferred embodiments

35 of a method and apparatus for video processing according to the invention are described hereinafter, as an entirely non-limiting example, with reference to the accompanying figures in which:

Figure 1 represents a block diagram of an apparatus used for implementing the method according to the invention;

Figure 2 schematically represents the 2:2 pull-
5   down conversion and processing;

Figure 3 schematically represents the movement sequence between the fields in the case of film processed by 2:2 pull-down;

Figure 4 schematically represents the 3:2 pull-
10   down conversion and processing;

Figure 5 schematically represents the movement sequence between the fields in the case of film processed of 3:2 pull-down.

15   Starting with interlaced video having 525 lines at 60 Hz or 625 lines at 50 Hz, the interlacing is firstly moved and the video is therefore first converted to non-interlaced video.

20   For this purpose use is made of a known or progressive scanning technique, in which a three-point median, obtained with the aid of median filter 1, carries out the compensation for movement.

25   In the case of interlaced video, each frame consists of two fields, successive even and odd fields being shifted by half a line with respect to one another. The three-point median has as its input the pixels lying vertically above one another of two successive lines
30   from the current field coming in via 1A and the pixel vertically below of the intermediate line of the following field coming in via 1B.

The result of the median processing, combined with the
35   original lines of the current image, provides a movement-compensated image of 625 or 525 lines, non-interlaced, and 50/60 Hz.

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The result of the median filter 1 is stored in a memory
bank (display bank) 2 which consists of two image FIFOs
3 and 4 which are written in interlaced form. The even
pixels go to FIFO 3, the odd pixels to FIFO 4.

5

"Doubling" is the constant read-out of the display bank
2 at the normal rate.

After interlacing has been removed, a stable image
10 without line flicker is obtained. To obtain optimal
screen coverage on CRT-based monitor systems, a
quadrupling technique is used additionally.

Simultaneously with the calculation of the median in
15 the median filter 1, vertically intermediate pixels are
calculated via vertical linear interpolation in the
interpolator 5, which connects, via 5A to the output of
the median filter 1. Again, 625/525 lines of non-
interlaced 50/60 Hz are obtained.

20

The result of this interpolation is stored in a memory
bank (display bank) 6 which, like the abovementioned,
consists of two image FIFOs 7 and 8 which are written
in interleaved form. The even pixels go to FIFO 7, the
25 odd pixels to FIFO 8.

To obtain a quadrupled image, a line of the display
bank 2 and a line of the display bank 6 is read
alternately by a memory controller 9, the result being
30 relayed to a digital-to-analogue converter 10.

Each line consists of 1024 pixels, 512 even pixels from
FIFO 3 or 7, and 512 odd pixels from FIFO 4 or 8, which
are read out in interleaved form and in the correct
35 pixel phase. Ultimately, a total image of 1250 or 1050
lines, non-interlaced, is obtained a line frequency of
64 kHz and a frame rate of 50 or 60 Hz, respectively.

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To render the plane flicker inherent to low frame rates
of 50 or 60 Hz invisible, recourse is moreover had to
field rate upconversion, which involves increasing the
frequency to 100 to 120 Hz.

5

In a first embodiment, the lines of the abovementioned
display bank 2 are read out by the memory controller 9
twice in succession and at twice the normal rate and
therefore at a frequency of 100 or 120 Hz instead of 50

10 or 60 Hz, an image being formed which has 625 or 525
lines,   respectively,   non-interlaced,   displayed   at
double the frame rate. The line frequency is then
64 kHz.

15 To retain the advantage of better screen filling, it
would be necessary to change to a line frequency of
128 kHz, which cannot be achieved by most display
equipment. To solve this problem, the memory controller
9, in a second embodiment, first reads out the entire

20 contents of the display bank 2 at twice the normal rate
and then, at twice the normal rate, reads out the
entire contents of the display bank 6. Since both
display banks 2 and 6 are alternately read out at twice
the rate, a resulting field rate of 100 or 120 Hz will

25 again be obtained.

Since the contents of the display bank 2 differ
spatially from the content of the display bank 6, it is
necessary to ensure that the data of both display banks

30 2 and 6, which do agree temporally, are not written to
the same position on the monitor. To achieve correct
interlacing at 100 or 120 Hz, the outgoing vertical
frame pulse (100/120 Hz) is then, every other frame,
shifted upwards by half a 64 kHz line.

35

As a result of the interlacing, the information from
the one display bank ends up in between the information
of the other display bank 6, which produces optimal

screen coverage within the same time as with normal quadrupling (20 ms or 16.6 ms).

This type of image, because of the interlacing using
5   non-equidistant frame pulses instead of equidistant frame pulses, can be used only on equipment which supports this type of interlacing, such as HDTV-compatible equipment.

10   The frame pulse for the second 100 or 120 Hz field must be calculated. The length of the frame is measured on the basis of the number of 64 kHz lines in an original field. The second frame pulse is positioned in the middle between two original frame pulses. Without
15   interlacing, equidistant 100 or 120 Hz frame pulses will be obtained.

The field rate upconversion can therefore be applied both to the doubling technique and to the quadrupling
20   technique, with the option of doubling and quadrupling being employed separately, in conjunction with field rate upconversion or without it. In the case of doubling, the display bank 2 is constantly read out at normal rate, in the case of quadrupling every other
25   line of the display banks 2 and 6 are read out at normal rate, in the case of doubling and field rate doubling the display bank 2 is read out constantly at double the rate, whereas in the case of quadrupling and field rate doubling, complete fields are read out
30   alternately from the display banks 2 and 6 at double the rate, followed by interlacing with respect to the frame pulse.

Apart from video mode, i.e. normal video recordings in
35   which movement can take place between each field (20 or 16.6 ms interval), the apparatus is able to process transmissions in other modes, including film mode or derivatives thereof such as video editing mode transmissions, in which mixing takes place of normal

video images with film mode images, and film editing
mode, in which the input consists entirely of film mode
images, but the correct sequence is missing.

5   Film mode can take the form of so-called "2:2 pull-
down", in which 24 film images per second are converted
into PAL 50 Hz with 50 images per second or 30 film
images per second are converted into NTSC 60 Hz with 60
images per second, or of so-called "3:2" pull-down",
10 where 24 film images per second are converted into NTSC,
60 Hz and therefore 60 images per second.

In the case of "2:2 pull-down", the film, in order to
be transmitted in the PAL transmission standard, is
15 slightly accelerated to 25 images per second, and each
film image or frame is then split into an even and an
odd image or field, so that two fields A and B or C and
D or E and F etc. are obtained which match one another
and occupy the same temporal position but are spatially
20 situated on a different location, i.e. are separated,
as seen vertically, by half a scan line, as represented
in the top section of Figure 2.

Each field A, B, C etc. consists of lines, 312.5 lines
25 in the case of PAL, which in Figure 2 exist as A_0, A_1,
A_2, etc. for field A, B_0, B_1, etc. for field B, etc.
The original film image can be restored by the even and
odd field successively being shown and interlaced on
the monitor.
30
Likewise, to be able to transmit a film having 30
images per second in NTSC standard, each image or frame
is analogously split into an even and an odd field.

35 In the case of "3:2 pull-down", as represented in the
top section of Figure 4, frames consisting of an even
and an odd field, for example field A and field B, are
composed from, on the one hand, even and odd fields
from the same instant and, on the other hand, an even

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field of one instant and an odd field of the other
instant, for example from odd field A, even field A',
odd field A, even field B, odd field B', etc, so that
ultimately 60 images per second are again achieved.

5

Starting from six original image frames, 15 interlaced
fields are produced. Successively, three images or
frames are split into an even and odd field obtained,
followed by two split frames comprising an even field

10   of one image and an odd field from another image, the
upshot being that for each five successive fields, one
field is repeated.

Film transmissions and therefore 2:2 and 3:2 pull-down

15   images will, given correct detection and processing,
give qualitatively much better results that normal
video images.

In the above-described de-interlacing, use is made of a

20   median filter 1 to obtain correct movement
compensation. A median filter has the drawback,
however, that it cannot readily cope with lines moving
diagonally with the result that small steps or
serrations, so-called "jaggies", are produced on the

25   diagonals.

This is a highly annoying effect, which is even more
noticeable in film transmissions in 2:2 or 3:2 pull-
down form.

30

To ensure that this effect is markedly reduced with
film transmissions, the de-interlacing must be effected
without a median filter.

35   In the first instance, therefore, a movement detector
11 is used to detect between which fields there is
movement and between which fields there is absolutely
no movement.

- 10 -

This is done by observing correlations between these fields.

To this end prefiltering is performed as a first step.

5

Successive fields A (comprising lines A_0, A_1, etc) and B (comprising lines B_0, B_1, etc), which may match, do come from the same instant but, as a result of the image having been split vertically when film was 10 converted to video transmission, they differ spatially.

Consequently it would be wrong for the pixel X from line A_0 to be compared with pixel X from line B_0, given that these are spatially separated; instead, the result 15 of the abovementioned median filter 1, i.e. the median of pixel X of A_0, A_1 and B_0 will be compared with the pixel X from line B_0, since this median spatially coincides with pixel X from line B_0.

20 This is enough to obtain a first improvement in being able to find possible correlation between a field A and a field B.

The result of the median filter 1, on the one hand, and 25 the information, coming in via 12, from the next field, on the other hand, are each filtered by means of a low-pass filter 13 or 14, for example a relatively inexpensive recursive filter, which continuously averages a number of successive pixels, for example 32, 30 in accordance with the equation:

$(32.x_{old} - 1.x_{old} + 1.x_{new})(1/32)$.

The movement correlation is performed on the low frequencies and not on sharp transitions or details, in 35 order not to be too strongly dependent on the net bandwidth of the input signal and on the possible errors of the median filter 1.

Then, for each pixel, the absolute difference is
calculated, in the differentiator 15, between the
result of the low-pass filter 13 for the result of the
median filter, and the low-pass filter 14 for the
5 incoming next image.

The successive absolute differences are summed in the
summator 16, and each time there is an overflow of, for
example, 2^9 or 512, the counter 17 connected thereto is
10 incremented. What this amounts to is that the total sum
of the absolute differences is divided, for example, by
512 in order to limit the magnitude of the final
number.

15 This process is carried out over an entire field, but
preferably also limited or keyed by so-called
"windowing" from a specific start line to a specific
stop line and from a specific start pixel to a specific
stop pixel.
20
At the end of each field, the output of the counter 17
yields a number which, in principle, indicates that
degree of movement between two successive video fields.

25 In a third step a relevant criterion is defined for
determining whether there is indeed movement or
standstill.

In the event of movement of bright images, the result
30 of the sum of the absolute differences between two
successive fields will, on average, be higher than in
the case of dark fields. Consequently, the calculation
of the threshold value for the movement criterion takes
account of the luminance value of the current image
35 being processed.

At the same time as the sum of the absolute
differences, therefore, the total sum of the luminances
is also calculated. The threshold value used for

movement is an empirically determined fraction of the
sum of the luminance values, for example 1/64th.
Depending on the current processing operation, this
threshold value can be doubled or halved.

5

If there are small details in the one image or field,
which shift with respect to the next image, for example
noise or detailed structures, this can have a
disruptive effect on the result of the movement
10 detection.

If the threshold value comes out too low, the result,
even with instantaneously standstill between successive
images or fields, may nevertheless be movement, this
15 being incorrect. Because of this, that information is
filtered out by means of the abovementioned low-pass
filters 13 and 14 in the prefiltering operation.

In as much as an edge boost, to be described
20 hereinafter, is employed prior to movement detection
taking place, which may be required for architectural
reasons in the case of quadrupling, details of fine
structures may after all play a significant part in
determining the threshold value so that it is
25 necessary, in calculating this threshold value, to take
account of the status of the edge boosting device. The
more pronounced the edge boost, the higher will the
ultimate threshold value be.

30 This additional adjustment of the threshold value as a
compensation for the edge boost is carried out
simultaneously on the nominal value, for example 1/64th
of the luminance value, double the value and half the
value.

35

The threshold value is then tailored to the processing
mode.

If this processing mode is the detection mode with
continuous monitoring of the incoming data, the
movement detection is set to nominal sensitivity, for
example 1/64th of the luminance value.

Should some film mode or other have been detected and
the processing have been tailored thereto, the movement
detection is set to low sensitivity, for example twice
the nominal threshold value.

In the case of a third mode, the film resynchronization
mode (referred to as "film resync mode"), where the
system is still in film mode but the movement detection
in a single instance has detected an incorrect film
phase, the processing reverts to standard median
processing and the movement detection is set to high
sensitivity, for example half the nominal threshold
value, to enable rapid detection.

The abovementioned threshold value for movement is
determined at the end of each field.

The film mode/video detection proper then takes place
as follows:

When the abovementioned result of the counter 17
exceeds said threshold value, there is movement between
the successive fields, and comparator 18, connected to
the counter 17, of the movement detector 11 will
generate a logical "1" which is clocked into a shift
register 19.

When, conversely, the abovementioned sum drops below
the threshold value, there is correlation or no
movement and the comparator 18 of movement detector 11
will detect a logical "0" which is likewise entered
into said shift register 19.

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The shift register 19 has a length of a number of bits, for example eleven bits, which means that the history of the movement detector 11 can be measured over a number of fields, for example eleven fields.

5

In the case of the film mode/video detection, a detector 20 scans the sequence of the shift register 19 for a specific pattern inherent to the various modes.

10   The output of the detector 20 is connected, via 20A to the comparator 18 for feedback of the threshold value which, in fact, is determined in said detector 20.

In the event of movement in the case of film processed
15   by 2:2 pull-down, i.e. where a film containing 24 images per second was converted to 50 images per second in PAL and transmission standard 50 Hz or a film with 30 images per second was converted to 60 images per second in NTSC 60 Hz, the movement sequence will be
20   0101010101..., as represented in Figure 3.

When the detector 20 therefore observes a 01010101.. sequence, the decision will be that a "2:2 pull-down mode" obtains.

25

In the event of movement in the case of film processed by 3:2 pull-down, i.e. where a film containing 24 images per second was converted to 60 images per second in NTSC 60 Hz, the movement sequence will be
30   1010010100101..., as represented in Figure 5, so that, when the detector 20 therefore observes this sequence, the decision will be that a "3:2 pull-down mode" obtains.

35   When the detector 20 observes a movement frequency 1111111, it is assumed that ordinary video obtains, which must be processed via standard median filtering.

The system, upon detecting a 2:2 or 3:2 "pull-down
mode" sets the film mode indication high, which means
that the movement detector 11 must be set to
insensitive mode and that the processing
5   synchronization must be started. The detection length
of the movement detection is also switched over to a
shorter word length of, for example, six bits instead
of eleven bits.

10   The abovementioned processing synchronization is
necessary to ensure, upon detection of the movement
sequences associated with 2:2 or 3:2 "pull-down mode",
that processing of the data will proceed in the correct
phase.
15

For the processing, the median filter 1 is switched off
and matching fields are merged, and the merged image is
repeated, as will be explained below in more detail.

20   For the purpose of this synchronization, the apparatus
includes a synchronizer 21 comprising two oscillating
shift registers, one of which, hereinafter referred to
as "3:2 pull-down syncer" 22, produces the sequence
10100 and repeats it indefinitely, or in other words
25   continuously produces the 3:2 pull-down processing
sequence, while the other one, hereinafter referred to
as "2:2 pull-down syncer" 23 produces the sequence 01
and repeats it or, in other words, continuously
produces the 2:2 pull-down processing sequence.
30

The output of the synchronizer 21 connects, via 21A, to
the abovementioned memory controller 9.

When one of the abovementioned film modes is detected
35   by the detector 20, the relevant pull-down syncer 22 or
23 is synchronized by a synchronization pulse coming
from the film mode/video detection, for example from
the detector 20. From that instant, the processing
operation is subjected to the activated syncer 22 or 23

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which indeed runs entirely synchronously with the
incoming film phase.

The activated syncer 22 or 23 also serves as a monitor
5   reference for the film mode/video detection. When the
syncer 22 or 23 outputs a zero, and the detector 20
outputs one, an error has crept into the film phase
(malfunction in the video source, too many vertical
on/off structures, situation of video editing,
10 incorrectly fitted "cue flashes" etc). In such a
situation, the apparatus will go into film resync mode,
the movement detector 11 being set to very high
sensitivity, and the processing will temporarily be
switched back to median filtering. For the purpose of
15 this error detection of the film phase, the output of
the synchronizer 21 forms part of a feedback loop, via
21B, to the detector 20.

These measures ensure that even if the movement is
20 slight and brief, there is still a good chance of
rapidly retrieving the new film phase. If there is too
much movement, the movement detector 11 will become
saturated, and there is a risk that the apparatus can
no longer distinguish between film mode and video mode.
25
The apparatus will then switch over to normal video
mode, i.e. normal median filtering, and will again
start to search for film mode using an eleven-bit word
length for the history of the movement detector 11 and
30 a nominal sensitivity. From this position, given
sufficient movement, the correct film phase will be
found again relatively rapidly. The switch-over in the
sensitivity of the movement detector 11 can be disabled
via an interface. There is then a choice of three fixed
35 settings of the sensitivity.

The film processing proper takes place as follows:

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A zero-to-one transition of the movement detector 1 means that movement has been detected between the successive fields. A one-to-one transition means continuous movement between the successive fields. A

5   zero-to-zero transition means standstill between the successive fields. A one-to-zero transition means a transition from movement to standstill between the successive fields.

10   If the correct film mode has been found and the syncer 22 or 23 is in the correct phase, the requirement, when the output of the syncer 22 or 23 is one, is for merging to take place of the successive fields, whereas, when the output of the syncer 22 or 23 is

15   zero, repetition of the merged field must take place, as schematically indicated in the bottom section of Figure 2 for the 2:2 pull-down or, in the bottom section of Figure 4, for the 3:2 pull-down.

20   In the case of 2:2 pull-down, the fields A and B, C and D etc. are merged, the line B_0 being introduced between the lines A_0 and A_1, the line B_1 between the lines A_1 and A_2, etc. The merged fields are each time repeated once, as represented by arrows at the bottom in

25   Figure 2.

In the case of 3:2 pull-down, the fields A and A', B and B' etc. are merged, the line A'_0 being introduced between the lines A_0 and A_1, the line A'_1 between the

30   lines A_1 and A_2, etc. The merged fields are each time repeated once or twice, as represented by arrows at the bottom in Figure 4.

Where in normal video mode the result of the median

35   filter 1 is combined with the original lines of the current field, the lines of the current field are now, via 21A and the memory controller 9, combined with the original lines of the next field, so that an image of 625 or 525 lines is produced which is simply the

merging of the even and odd field from one and the same image of the film.

5   What is introduced between the successive lines is therefore not the median but the line of a following field. In the case of 2:2 pull-down, for example, the line B_0 is introduced between the lines A_0 and A_1, as represented in Figure 2, and in the case of 3:2 pull-down, as represented in Figure 4, the line A'_0 is
10   introduced, for example, between the lines A_0 and A'_1.

In the case of film mode, the median filter 1 is therefore solely used for measuring but not for processing.
15
This result of the merger is relayed to display bank 2.

The abovementioned information is also relayed, via the median filter 1, to the interpolator 5, so that the
20   interpolation is also performed on the merged fields. The result of the interpolation is relayed to the display bank 6.

The display banks 2 and 6 are read out as described
25   above.

The repetition of the merged fields, which is represented at the bottom in Figures 2 and 4 by arrows, is effected by preventing writing to the display banks
30   2 and 6, so that, when these display banks 2 and 6 are read out, the same so-called "old" information is read out.

The matching even and odd fields coming from one and
35   the same film image are merged once more until the original film image is obtained, and this image is repeated until it is again possible for a following original film image to be constructed by means of the abovementioned merger.

As already stated previously, the edges and the details
of the video images can be enhanced selectively by a
so-called "edge boost".

5

Such an enhancement is performed on the incoming signal
by means of two phase-linear "finite impulse response"
or FIR filters having a sum of coefficients of 0, the
one being a band-pass filter having the coefficients -1
10   0 2 0 -1 and the other a high-pass filter having the
coefficients -1 2 -1. The sample frequency is 16 MHz.

The results of the two filters are merged and scaled,
for example divided or multiplied, and added to the
15   original video signal. Both filters, for example, have
eight settings. This allows for various combinations of
the two filters.

If excessively pronounced edges are detected, the
20   filter effect can be attenuated, if required, to
prevent deadlocks.

The invention is by no means limited to the embodiments
described hereinabove and represented in the figures,
25   such a method and apparatus for video processing being
capable of being implemented in diverse variations
without falling outside the scope of the invention.

Claims

1.   Method for video processing, wherein possible
movement between successive fields of the images split
5 into even and odd is detected and the mode, i.e. video
mode or film mode is determined, characterized in that
the   sequence   of   movement   or   standstill   between
successive fields is detected and this sequence over a
number of fields is stored in a memory, followed by
10 said sequence being compared with patterns inherent to
the   mode   and,   if   ordinary   video   mode   is   detected,
median filtering is carried out whereas, if film mode
(2:2 pull-down of 3:2 pull-down) is detected,   the
median   filtering   is   switched   off   and,   in
15 synchronization with the film phase, the even and odd
fields which match and are derived from one and the
same film image are merged again until the original
film image is obtained and said image is repeated until
again   a   following   original   film   image   can   be
20 constructed by means of the abovementioned merging.

2.   Method according to Claim 1, characterized in
that if a film mode is detected, the length of the
movement sequence which is stored in the memory is
25 shortened.

3.   Method according to any one of the preceding
claims, characterized in that the movement detection,
i.e. the detection of the abovementioned sequence of
30 movement and standstill, can be performed by a three-
point median filtering operation, after which the
result of said median filtering operation and the
incoming information of a following field is filtered
by two low-pass filters, the absolute difference of the
35 result of these two low-pass filter is calculated and
the differences are summed, the sum, possibly divided
by a number, being compared with a threshold value, the
result of said comparison forming the abovementioned

sequence, stored in a memory, of the movement and
standstill between successive fields.

4.   Method according to Claim 3, characterized in
that, depending on whether the abovementioned sum is
larger or smaller than the threshold value, a different
binary number is stored in a memory, the sequence of
binary   numbers   in   said   memory   forming   the
abovementioned sequence of movement and standstill
between successive fields.

5.   Method according to Claim 3 or 4, characterized
in that the threshold value is calculated taking into
account the luminance value of the current processed
image.

6.   Method according to Claim 5, characterized in
that the total luminance sum is calculated and the
nominal threshold value chosen is a specific fraction
of said luminance sum, said nominal value optionally
being adjusted, in particular being doubled or halved,
in order to take account of the processing mode and, if
edge boosting is being carried out, to take account of
the status of said edge boosting.

7.   Method according to any one of the preceding
claims,   characterized   in   that,   if   film   mode   is
detected, the processing of the data is synchronized
with the film phase by using oscillating shift
registers   to   continuously   transmit   a   sequence
corresponding to the 2:2 pull-down mode and/or a
sequence corresponding to the 3:2 pull-down mode and,
if one of the corresponding mode is detected, to
synchronize with a synchronization pulse transmitted by
the detection of the sequences of movement and
standstill between the successive fields.

8.   Method according to Claim 7, characterized in
that in the event of non-synchronization or detection

of an error in the film phase, a changeover to film the
synchronization mode is carried out, the sensitivity of
the detection of movement again being set to a high
level and the processing temporarily again being
5   carried out by median filtering until the film phase is
observed again.

9.   Method according to any one of Claims 5 to 8,
characterized in that in the event of film mode being
10   detected and of synchronization the threshold value is
increased so that the sensitivity of the detection of
movement or standstill decreases.

10.   Method according to any one of the preceding
15   claims, characterized in that the incoming signals are
subjected to edge boost by said signals being filtered
by means of two phase-linear filters having a
coefficient sum of 0, namely a band-pass filter
preferably having the coefficients -1 0 2 -1 and a
20   high-pass filter having, for example, the coefficients
-1 2 -1, after which the result of these filtering
operations is merged and scaled.

11.   Method according to any one of the preceding
25   claims, characterized in that the video signals to be
processed are subjected to doubling or quadrupling
and/or field rate doubling.

12.   Method according to Claim 11, characterized in
30   that the interlaced video signals to be processed are
converted into non-interlaced video signals by means of
a 3-point median filtering operation whose result is
stored in a memory bank, and a field rate upconversion
is performed by said memory bank constantly being read
35   out at a higher rate than normal, preferably double the
rate, for example at a frequency of 100 or 120 Hz
instead of 50 or 60 Hz.

13.   Method according to Claim 11, characterized in
that the interlaced video signals to be processed are
converted into non-interlaced video signals by means of
a 3-point median filtering operation whose result is
5   stored in a first memory bank and these video signals
are simultaneously subjected to an interpolation whose
result is stored in a second memory bank, after which
successively a line from the one and a line from the
other   memory   bank   is   read,   and   a   field   rate
10 upconversion   is   performed   by   the   contents   of
successively   the   first   and   the   second   memory   bank
constantly being read out at a higher rate than normal,
preferably double the rate, for example at a frequency
of   100   or   120   Hz   instead   of   50   or   60   Hz,   and,   for
15 correct   interlacing,   the   outgoing   frame   pulse   being
shifted, every other frame, by half a line.

14.   Apparatus for employing the method according to
any one of the preceding claims, characterized in that
20 it includes a movement detector (11), a film mode/video
mode detector connected thereto, a synchronizer (21) to
synchronize processing with the film phase, and a film
processor proper.

25 15.   Apparatus according to Claim 14, characterized
in that the movement detector (11) is connected to a
median filter (1) having as inputs the current field
and the next field of the video images, and includes
two low-pass filters (13 and 14), one of which connects
30 to the output of the median filter (1) and the other
has   as   an   input   (12)   the   information   of   the   next·
incoming field, a differentiator (15) which connects to
the two low-pass filters (13 and 14) to calculate the
difference   between   the   outputs   of   these,   a   summator.
35 (16) connected to said differentiator (15), a counter
(17) connected to said summator (16) and a comparator
(18) connected thereto for comparing the output of the
counter (17) with a threshold value.

16.   Apparatus according to Claim 15, characterized
in that the film mode/video mode detector includes a
shift register (19) in which the result of the
comparator (18) over a number of fields is stored, so
5   that a comparison is possible with a pattern inherent
to a specific mode.

17.   Apparatus according to any one of Claims 14 to
16, characterized in that the synchronizer (21)
10   includes at least one oscillating shift register or so-
called "syncer" (22 or 23) which continuously transmits
the sequence corresponding to the sequence of movement
and standstill between successive fields for 2:2 pull-
down or 3:2 pull-down, respectively, and preferably two
15   shift registers or "syncers" (22 and 23), one for 2:2
pull-down and one for 3:2 pull-down.

18.   Apparatus according to any one of Claims 14 to
17, characterized in that the film processing proper
20   includes means for merging matching fields of a film
image and for repeating the merged images.

19.   Apparatus for video processing, characterized
in that they include means for employing doubling
25   and/or means for performing quadrupling, and a field
rate converter from, for example, 50 or 60 Hz to 100 or
120 Hz.

20.   Apparatus according to any one of Claims 14 to
30   18 and according to Claim 19, characterized in that as
well as a movement detector (11), a film mode/video
mode detector, a synchronizer (21) and a film processor
it includes means for employing doubling and/or means
for performing quadrupling, and a field rate converter.
35
21.   Apparatus according to Claims 15 and 20,
characterized in that the means for performing doubling
and/or the means for performing quadrupling include a

median filter (1) which also forms part of the movement
detector (11).

Fig.1

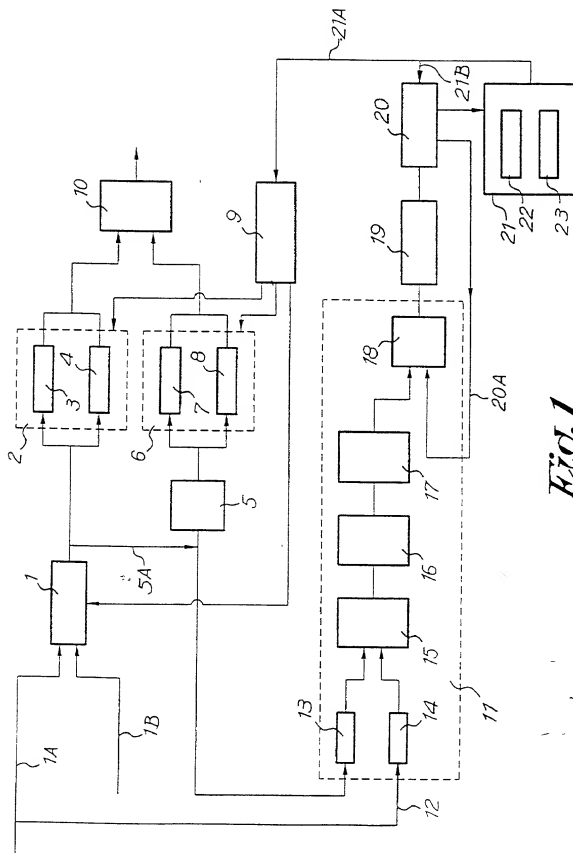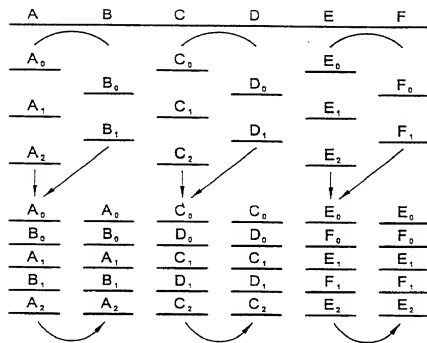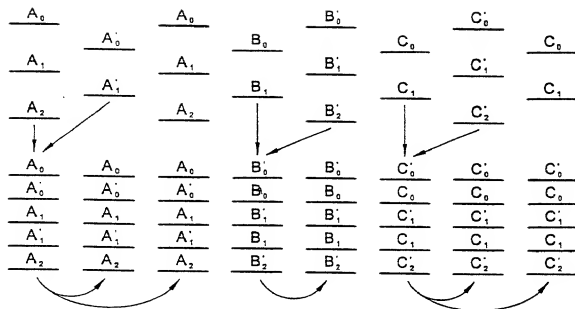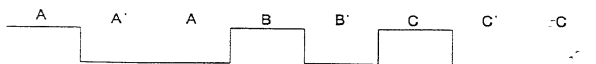| A	B	C	D	E	F
A_0		C_0		E_0	
	B_0		D_0		F_0
A_1		C_1		E_1	
	B_1		D_1		F_1
A_2		C_2		E_2	
A_0	A_0	C_0	C_0	E_0	E_0
B_0	B_0	D_0	D_0	F_0	F_0
A_1	A_1	C_1	C_1	E_1	E_1
B_1	B_1	D_1	D_1	F_1	F_1
A_2	A_2	C_2	C_2	E_2	E_2

Fig.2

A   B   C   D   E   F

Fig.3

Fig.4

Fig.5

|||||||||||||||||||||||||||||||||||||

23364

PATENT TRADEMARK OFFICE

Attorney/Docket No. _____

DECLARATION FOR PATENT APPLICATION
AND APPOINTMENT OF ATTORNEY

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name; I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention (Design, if applicable) entitled "Method and apparatus for video signal processing".

_____

the specification of which (check one):   [ ] is attached hereto; [ ] was filed on _____ as Application Serial No. _____ and was amended on (or amended through) _____ (if applicable); was filed as International Application (PCT) No. **PCT/EP 99/06555** and amended on _____ (if applicable). I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment(s) referred to above. I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a). I hereby claim foreign priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)   Priority Claimed

No. 09800669	Belgium	15 September 1998	[X]₁ [ ]
(Number)	(Country)	(Day/Month/Year Filed)	Yes No [ ] [ ]
(Number)	(Country)	(Day/Month/Year Filed)	Yes No [ ] [ ]
(Number)	(Country)	(Day/Month/Year Filed)	Yes No [ ] [ ]
(Number)	(Country)	(Day/Month/Year Filed)	Yes No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

_____

(Appln. SN)   (Filing Date)   (Status - Patented, Pending or Abandoned)

_____

(Appln. SN)   (Filing Date)   (Status - Patented, Pending or Abandoned)

I HEREBY DECLARE THAT ALL STATEMENTS MADE HEREIN OF MY OWN KNOWLEDGE ARE TRUE AND THAT ALL STATEMENTS MADE ON INFORMATION AND BELIEF ARE BELIEVED TO BE TRUE; AND FURTHER THAT THESE STATEMENTS WERE MADE WITH THE KNOWLEDGE THAT WILLFUL FALSE STATEMENTS AND THE LIKE SO MADE ARE PUNISHABLE BY FINE OR IMPRISONMENT, OR BOTH, UNDER SECTION 1001 OF TITLE 18 OF THE UNITED STATES CODE AND THAT SUCH WILLFUL FALSE STATEMENTS MAY JEOPARDIZE THE VALIDITY OF THE APPLICATION OR ANY PATENT ISSUED THEREON.

Attorney/Docket No. _____

POWER OF ATTORNEY: I (We) hereby appoint as my (our) attorneys, with full powers of substitution and revocation, to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: J. Ernest Kenney, Reg. No. 19,179; Eugene Mar, Reg. No. 25,893; Richard E. Fichter, Reg. No. 26,382; Charles R. Wolfe, Jr., Reg. No. 28,680; Bruce H. Troxell, Reg. No. 26,592; Thomas J. Moore, Reg. No. 28,974;

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